Modeling Energy and Sustainable Growth: Lessons from California

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City Club of Berkeley

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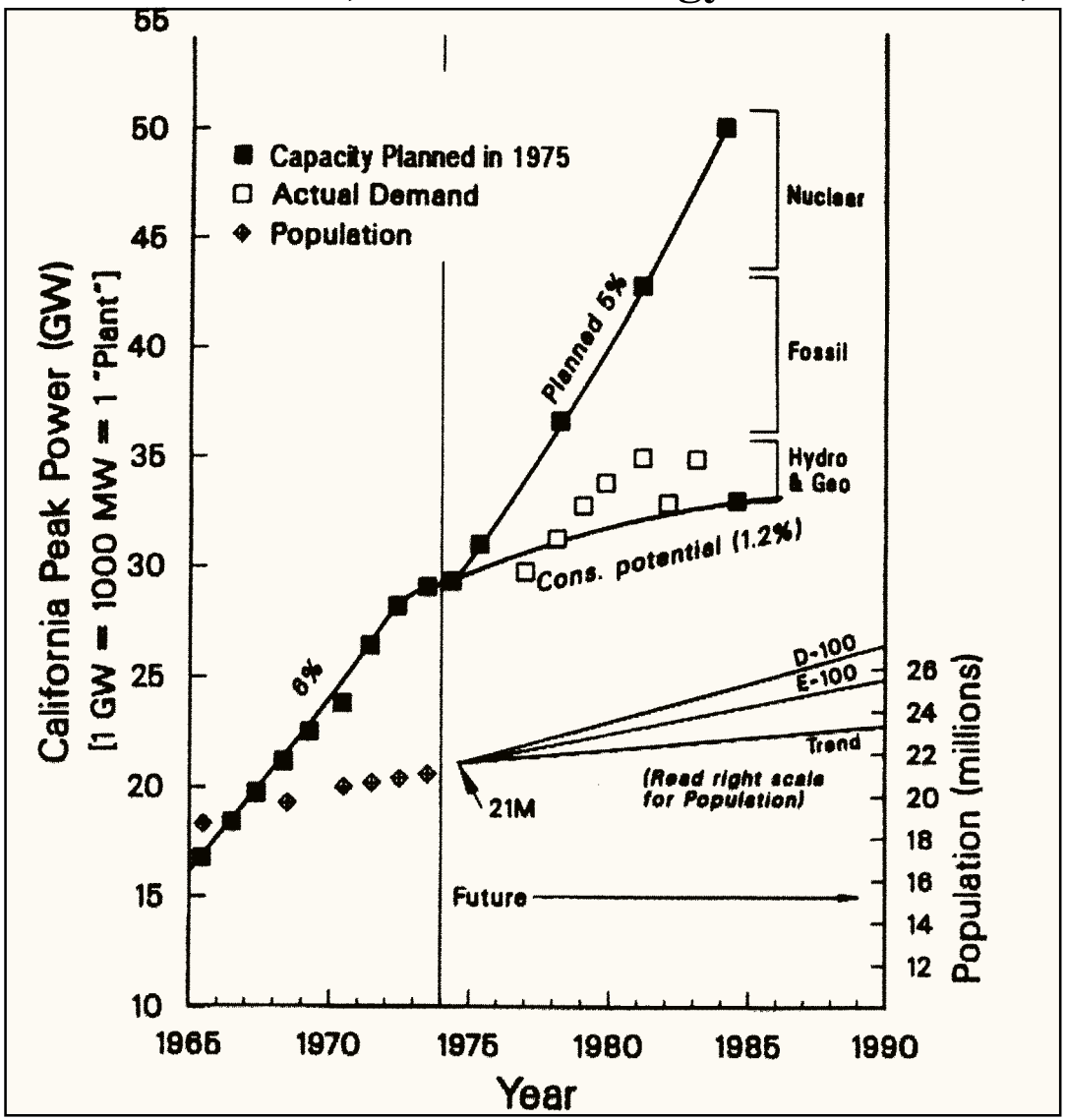
http://www.energy.ca.gov/commission/commissioners/rosenfeld.html

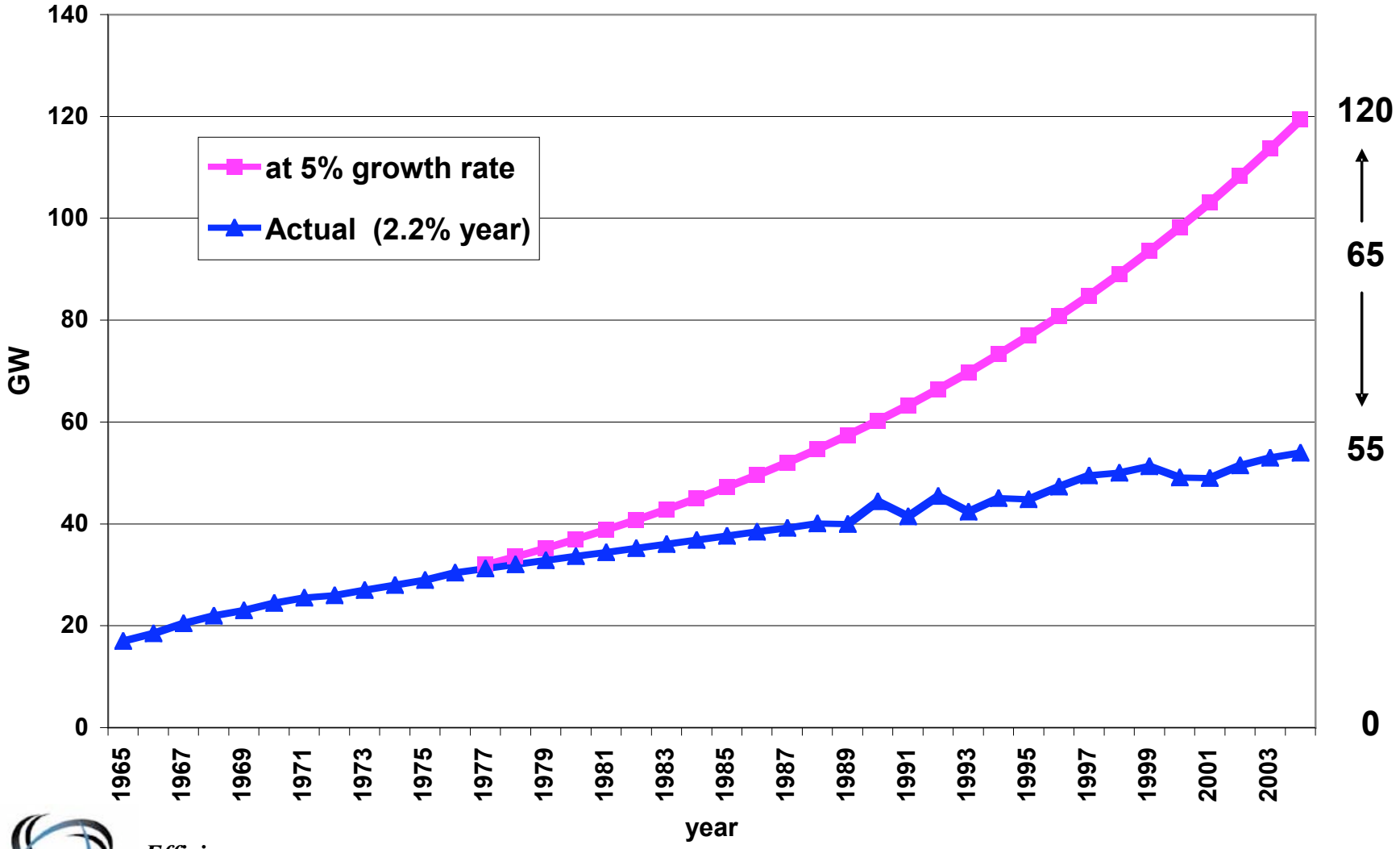
Efficiency
Energy for the Future

California Peak Power Demand:Planned in 1974, and Actual to 1984

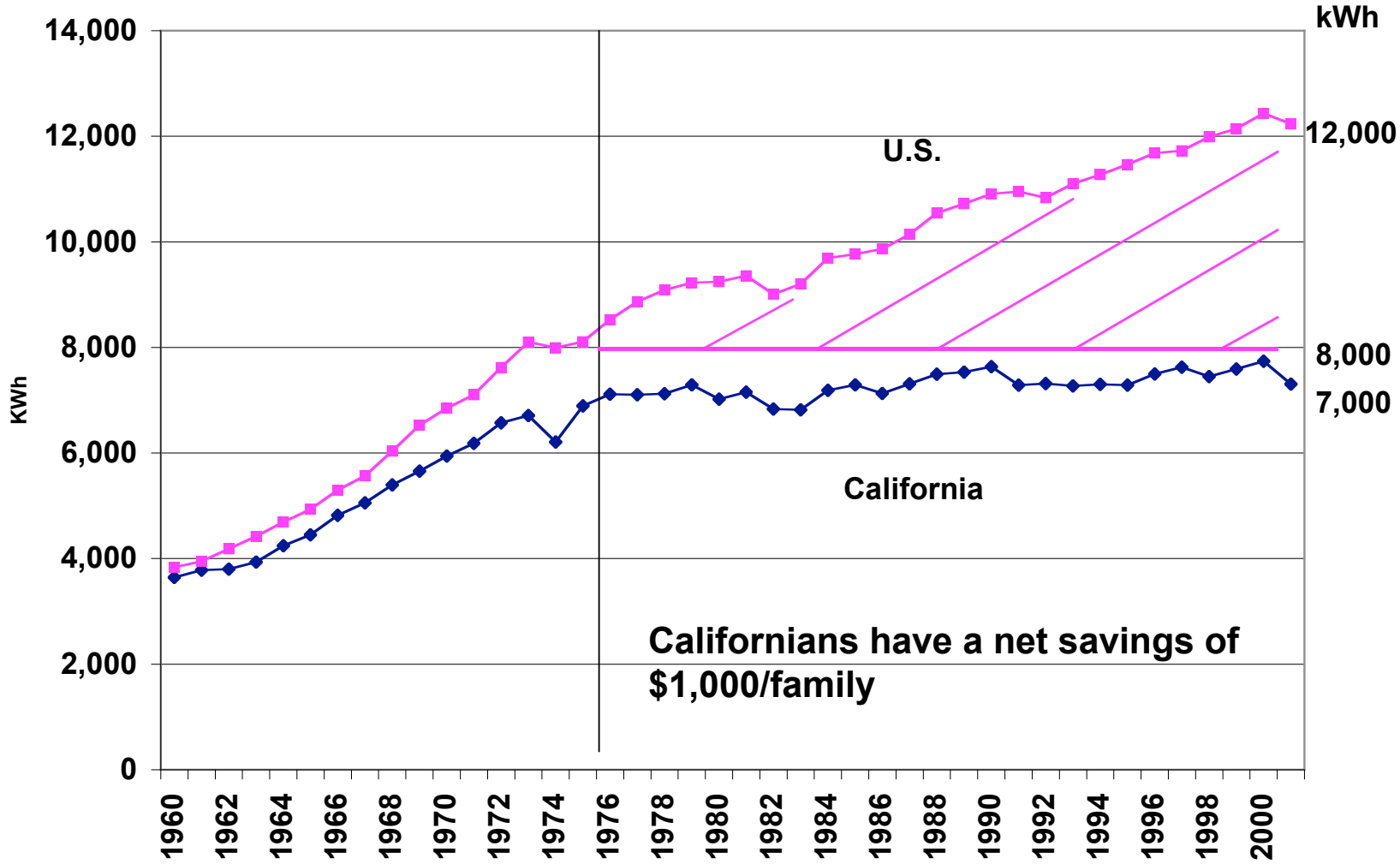
Goldstein and Rosenfeld, at Calif. Energy Commission, Dec. 1975



California Peak Demand 1965 - 2004

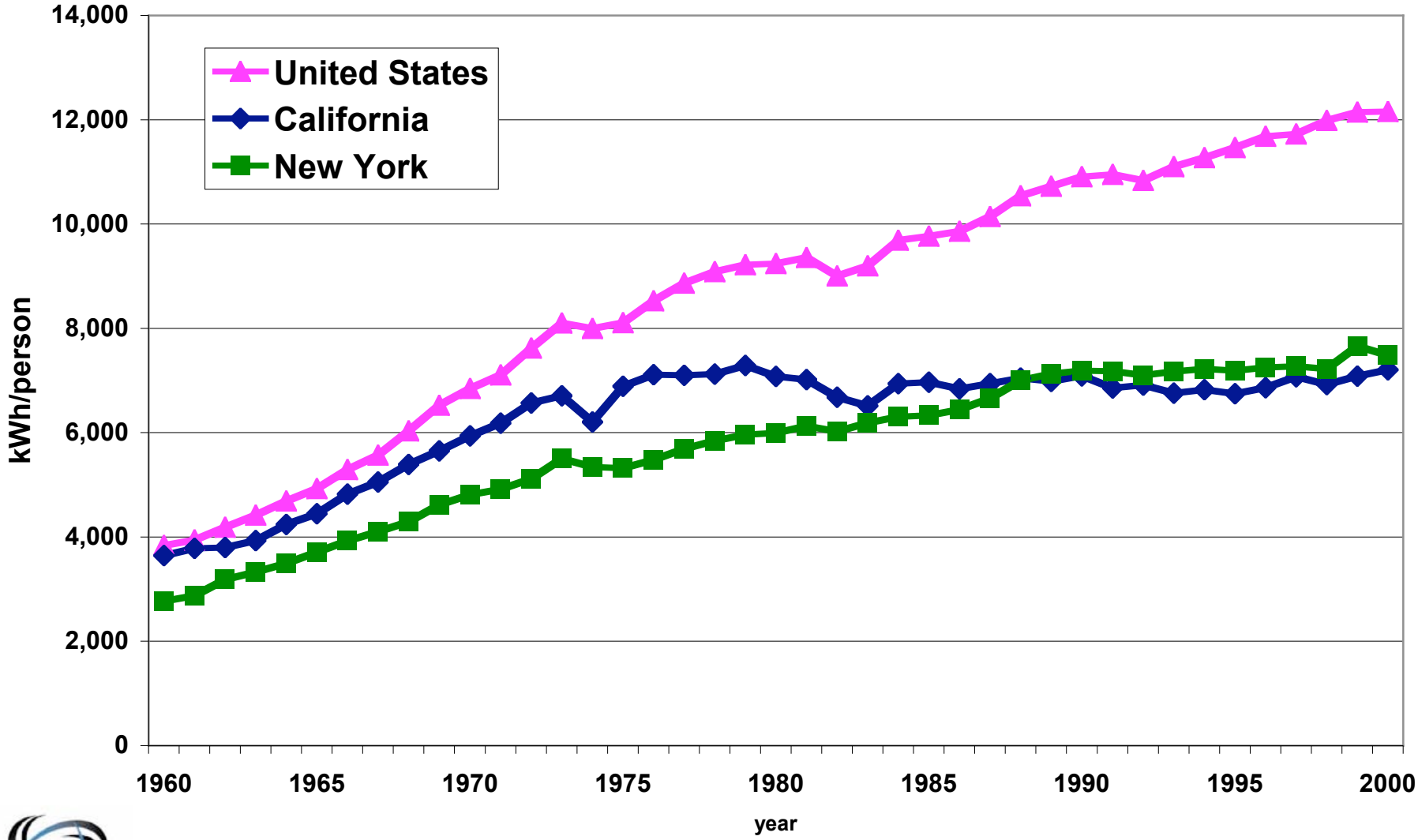


Total Electricity Use, per capita, 1960 - 2001

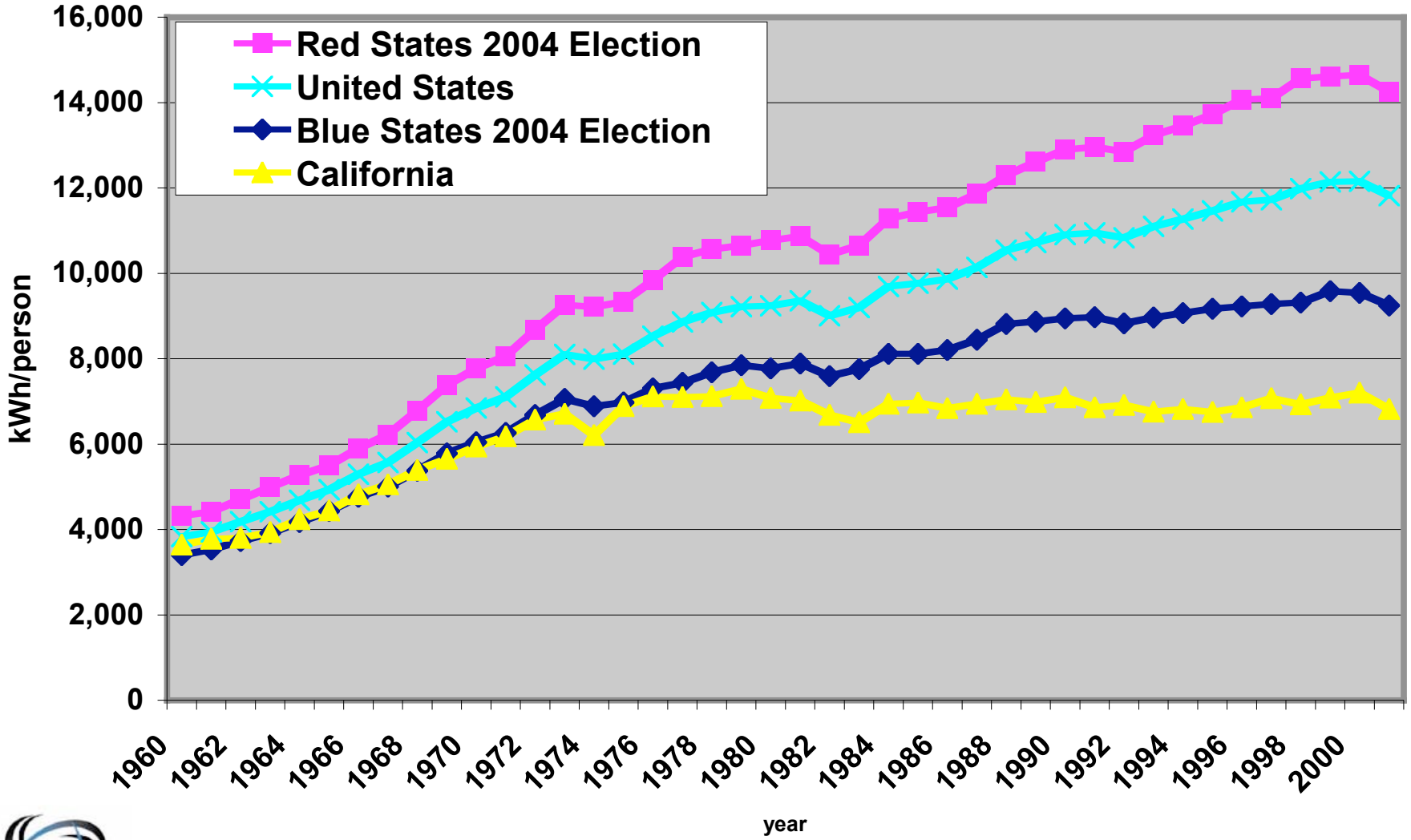


Per Capita Electricity Consumption

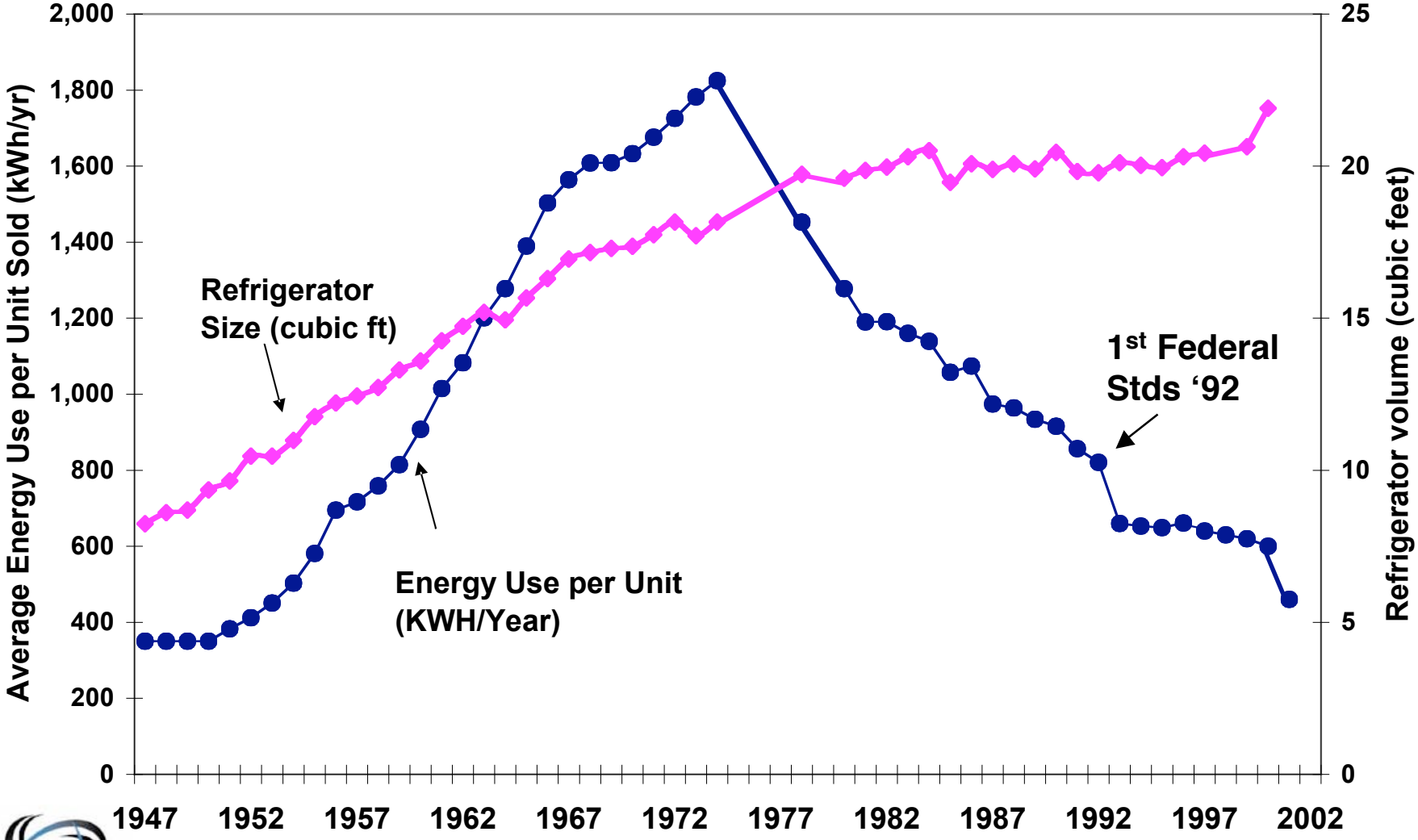
Source: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_csv



Per Capita Electricity Consumption

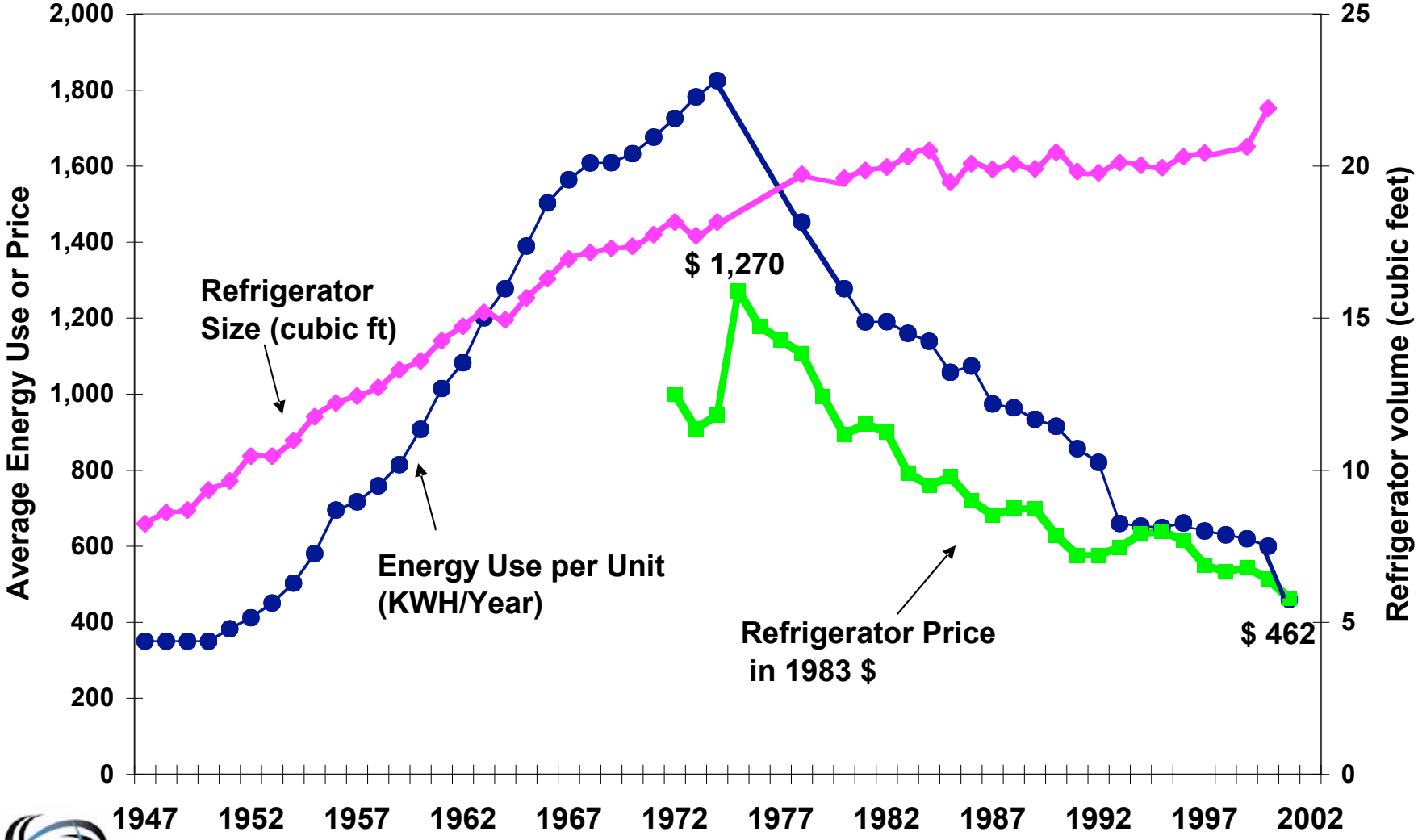


United States Refrigerator Use v. Time



Source: David Goldstein

United States Refrigerator Use v. Time



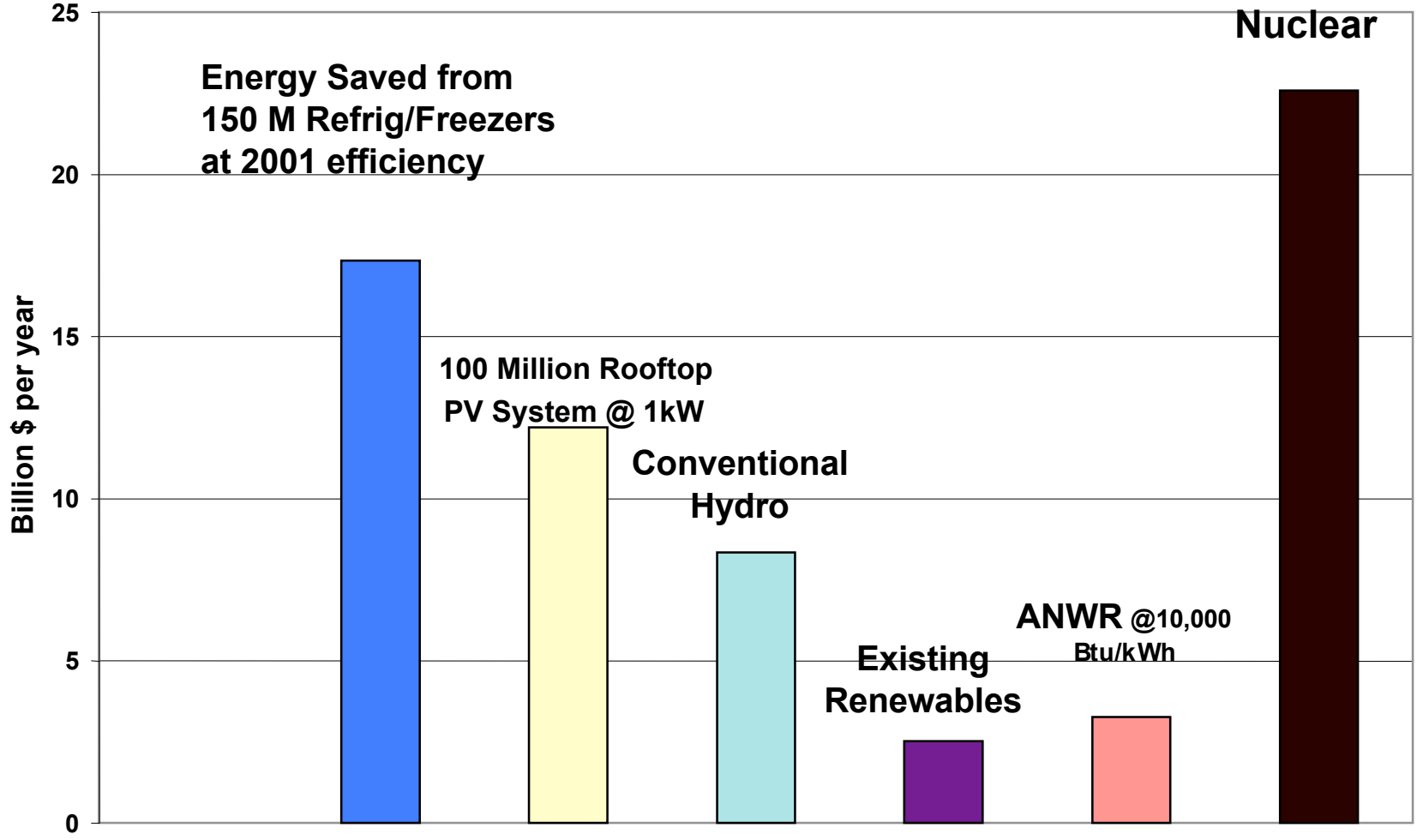
Efficiency

Energy for the Future

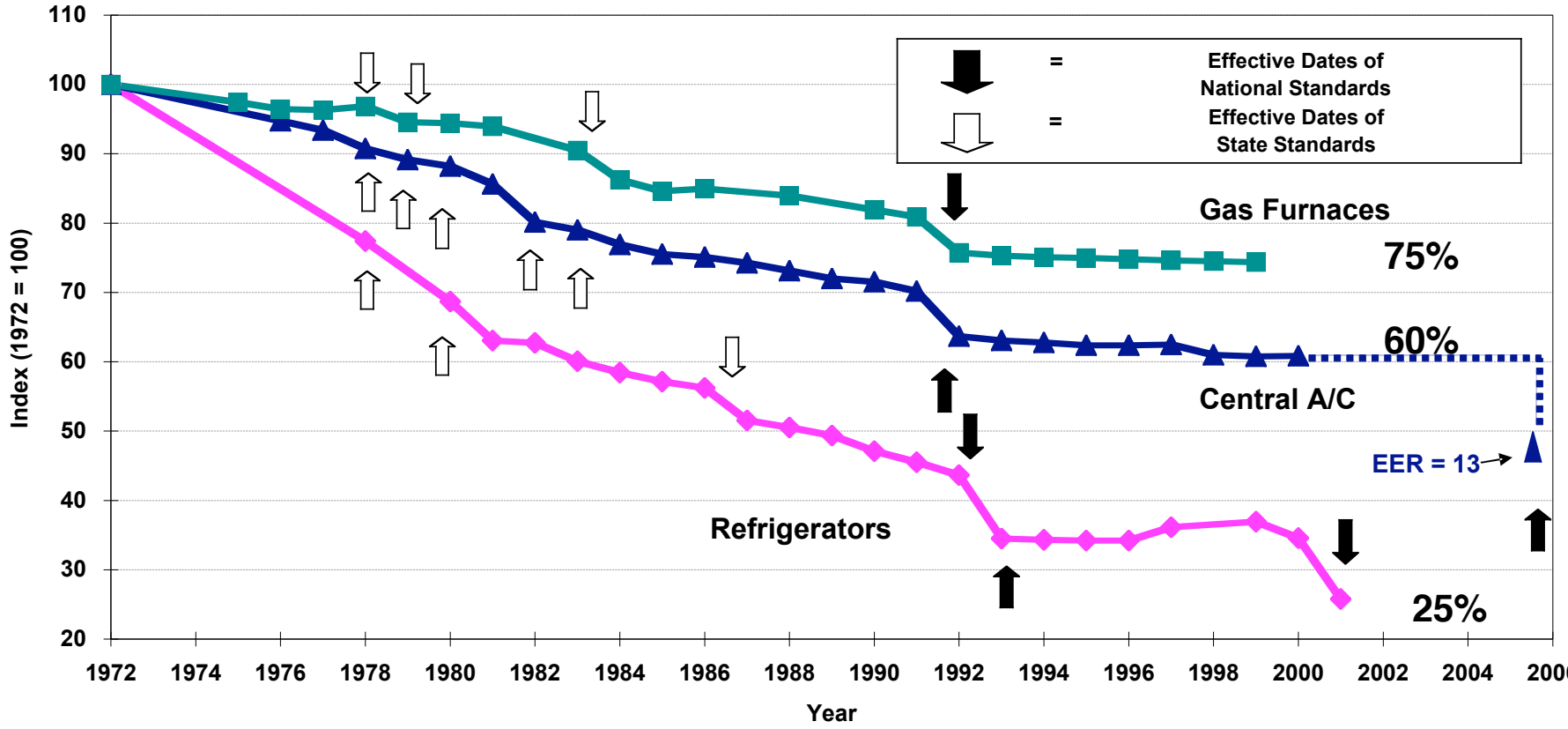
Source: David Goldstein

The Value of Energy Saved and Produced

(production @ .03 and savings @ .085 $/kWh)



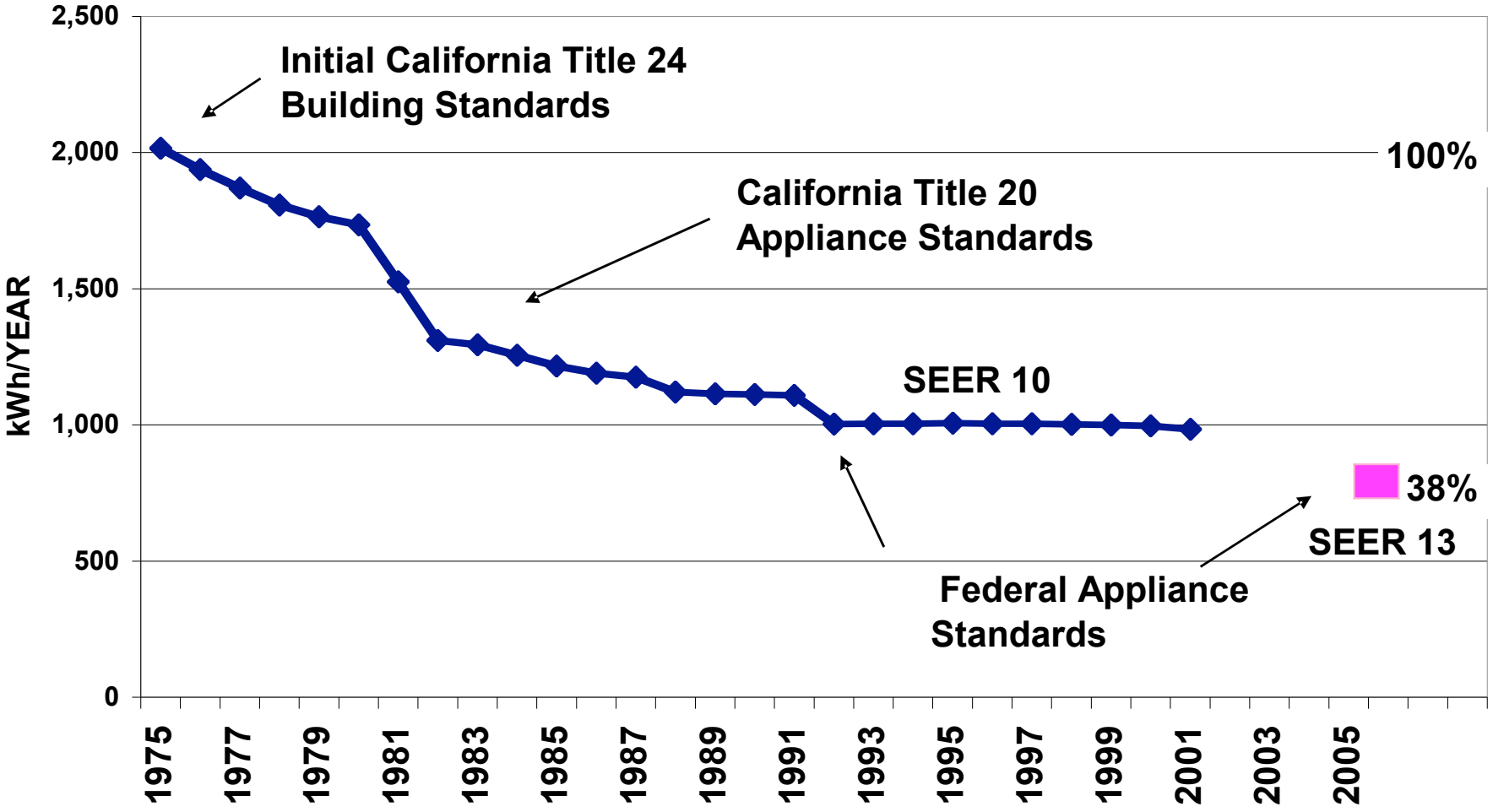
Impact of Standards on Efficiency of 3 Appliances



Source: S. Nadel, ACEEE,

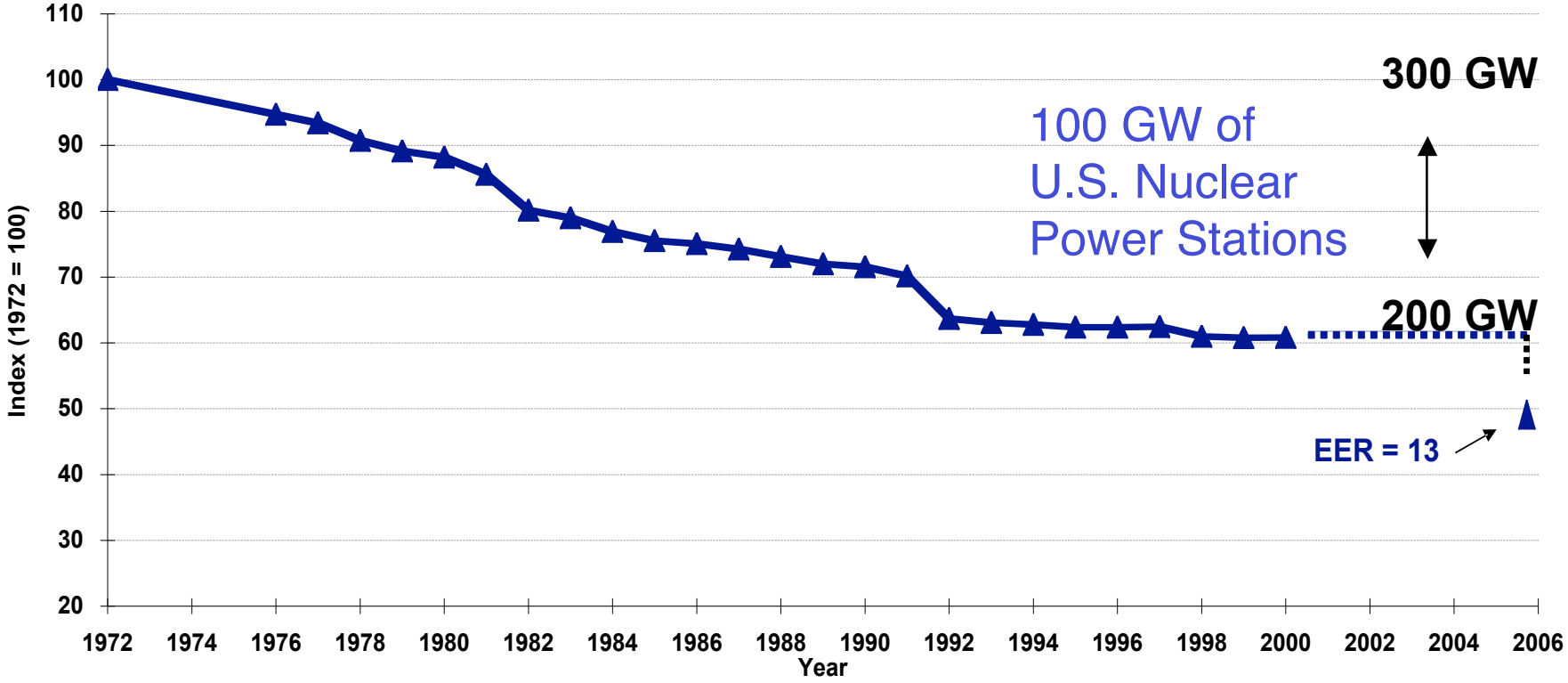
in ECEEE 2003 Summer Study, www.eceee.org

Annual Usage of Air Conditioning in New Homes in California
Average drop of 3% per year while House size grew 1% per year



Source: CEC Demand Analysis Office

After Saturation (16 years)
Impact of Standards on Residential Central A/C and Roof Top A/C Units in the United States

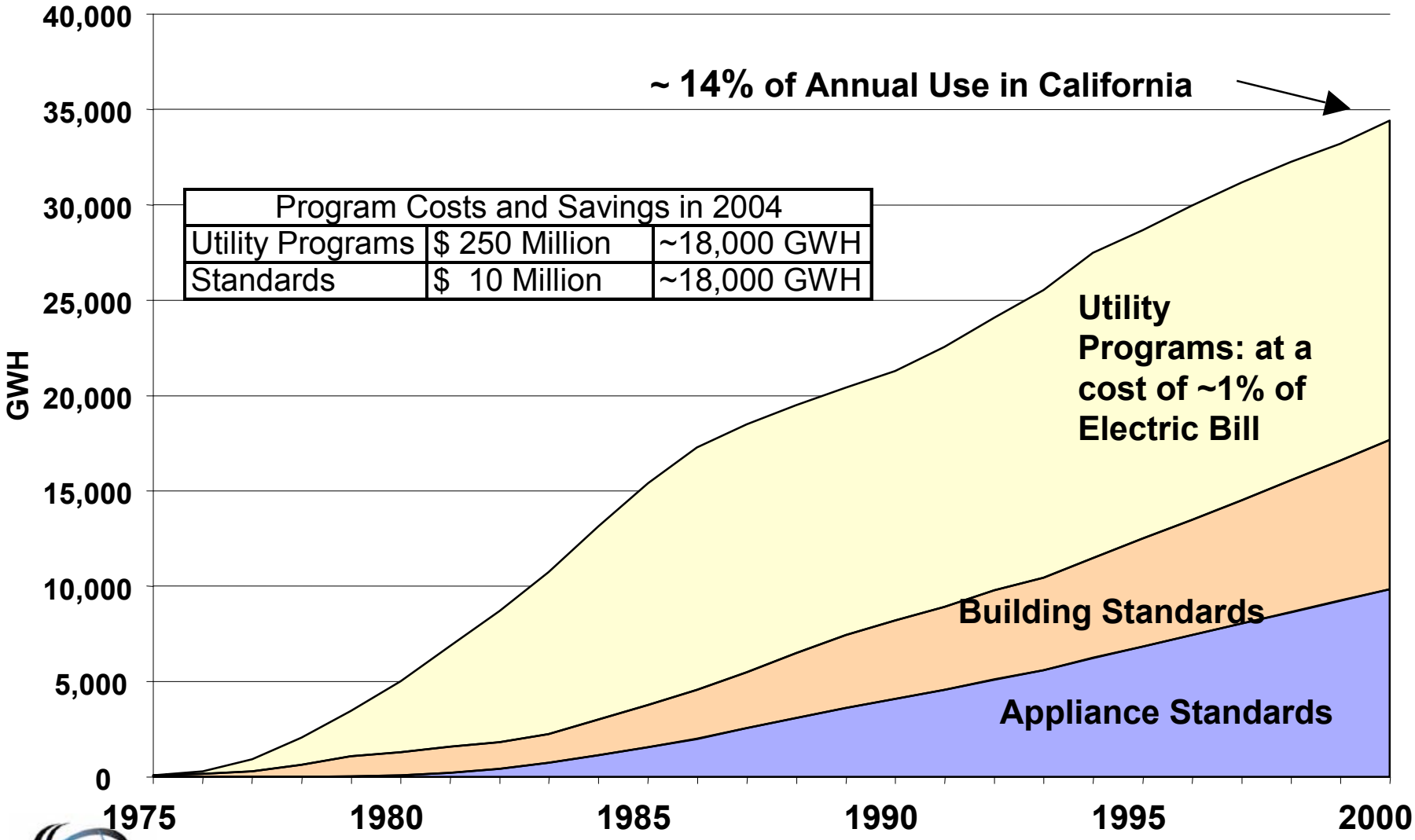


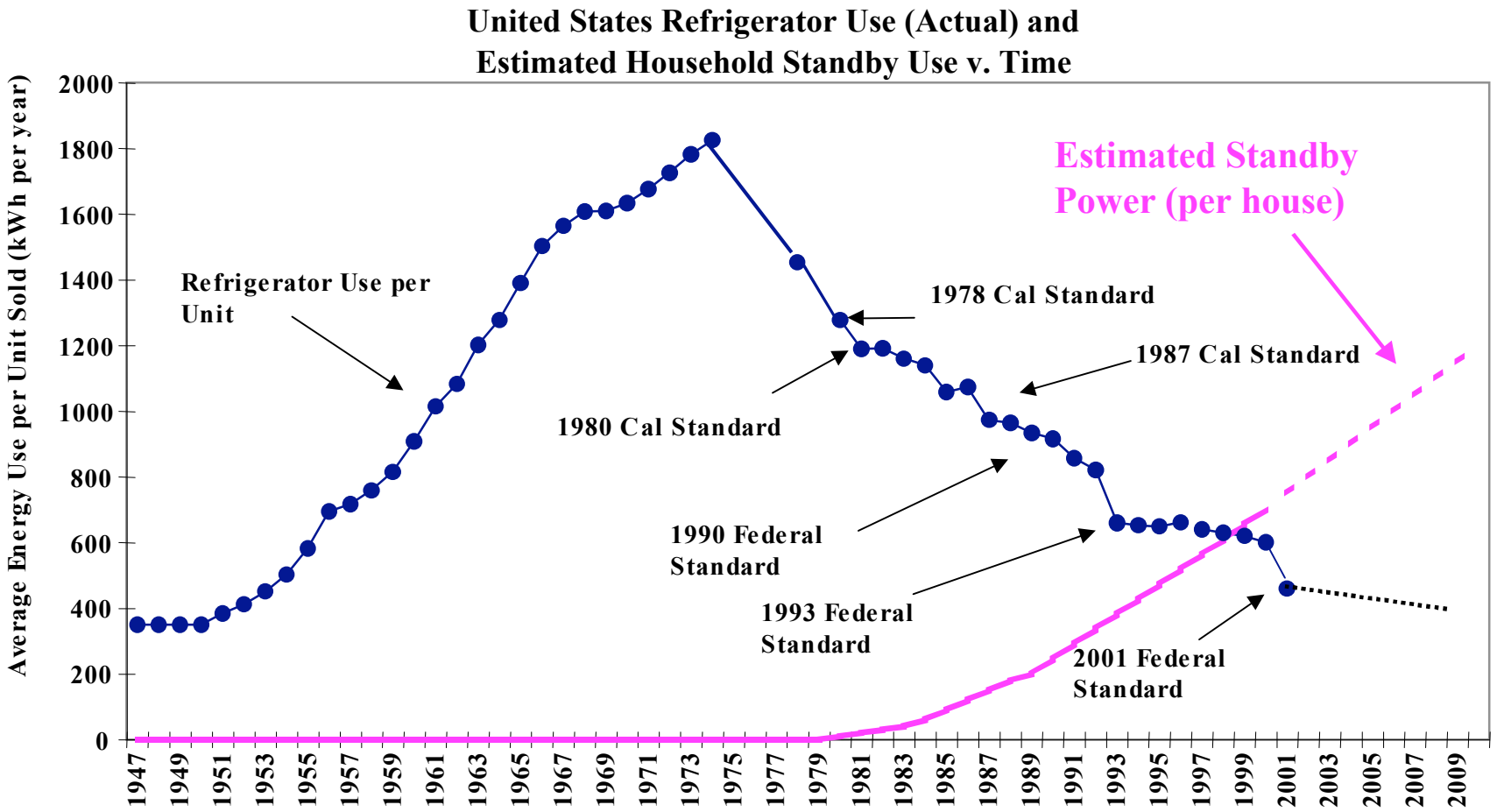
Costs and Pollution Saved by Avoiding a 50% expansion of California Electric System.

- Avoids 18 Million tons/year of Carbon
- Equivalent to getting 12 million cars off the road,
  - along with their NOx, CO, and particulate emissions.
- California has ~25 million motor vehicles,
  - **avoided 50% more equivalent pollution**.
- The Pavley bill, starting in model year '09, should start to reduce another 30%.

- California annual electric bill in 2004 ~ $30 Billion
- Avoided ~$16 Billion of bills, but net saving is only ~$12Billion/year, i.e**. $1000/family.**

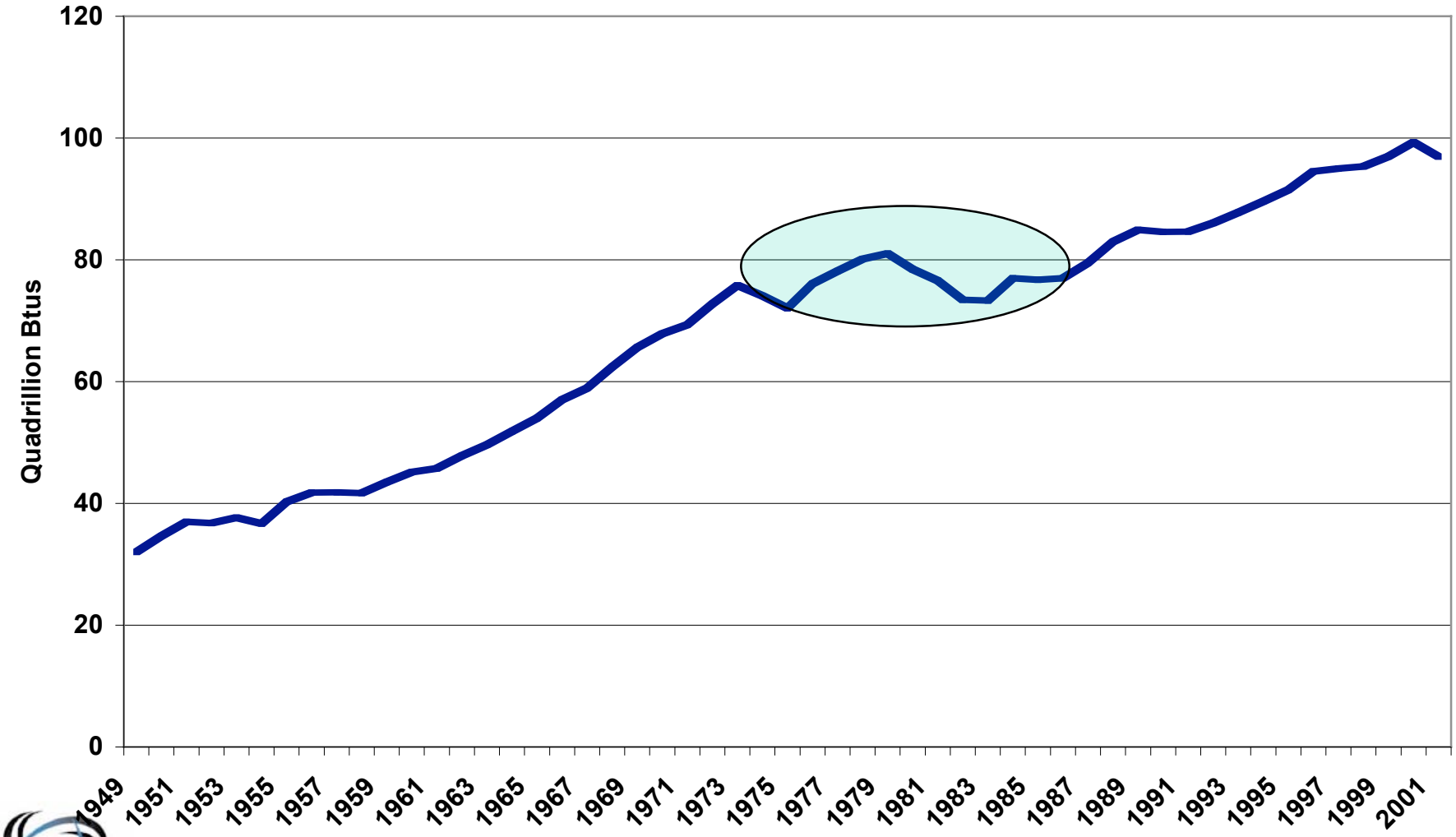
GWh Impacts from Programs Begun Prior to 2001



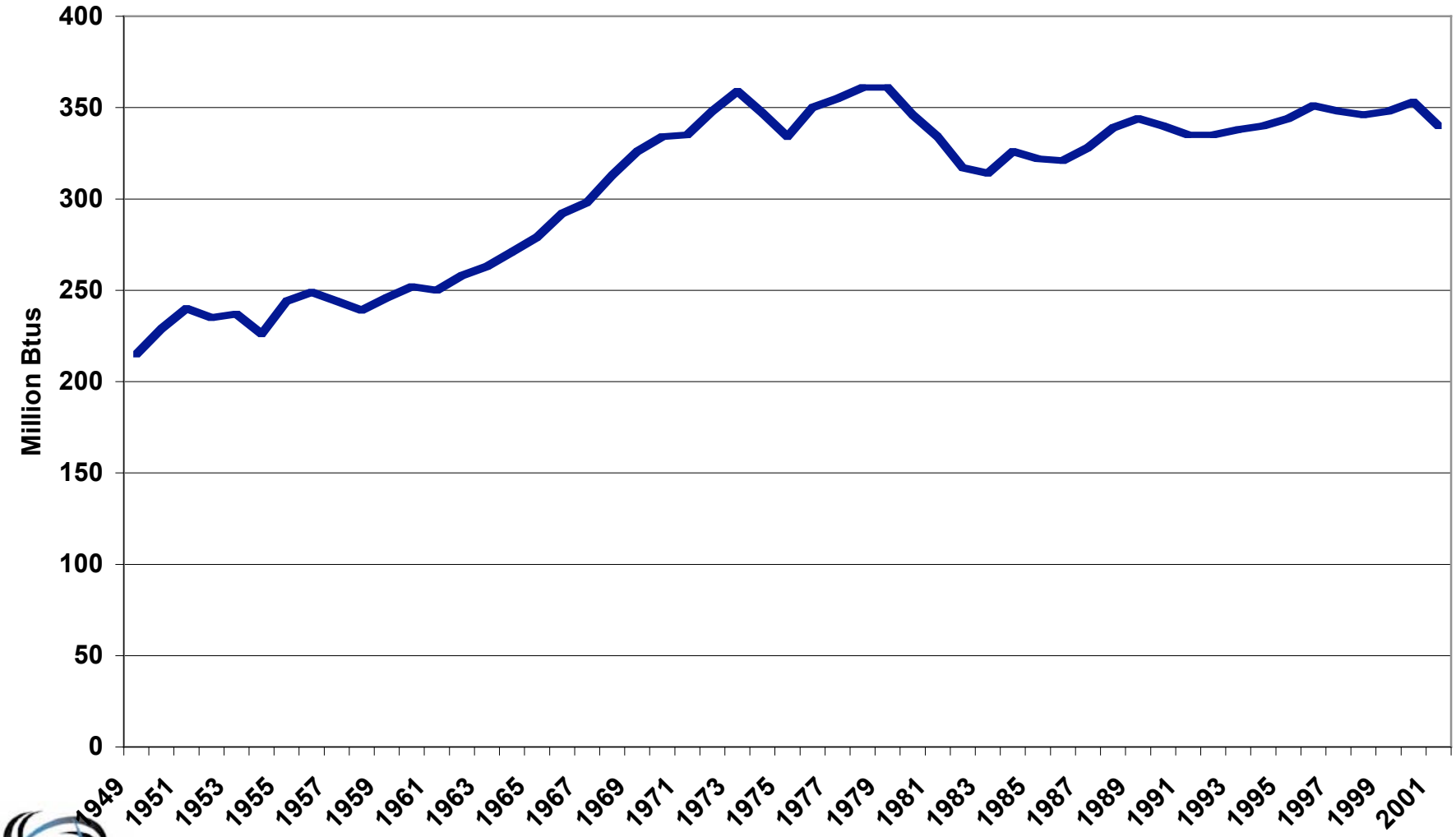

United States Refrigerator Use (Actual) and
Estimated Household Standby Use v. Time
Average Energy Use per Unit Sold (kWh per year)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Refrigerator Use per Unit
Estimated Standby Power (per house)
1978 Cal Standard
1987 Cal Standard
1980 Cal Standard
1990 Federal Standard
1993 Federal Standard
2001 Federal Standard

United States Energy Consumption 1949 to 2001

Source: Table 1.5 Annual Energy Review; data for 2001 is preliminary

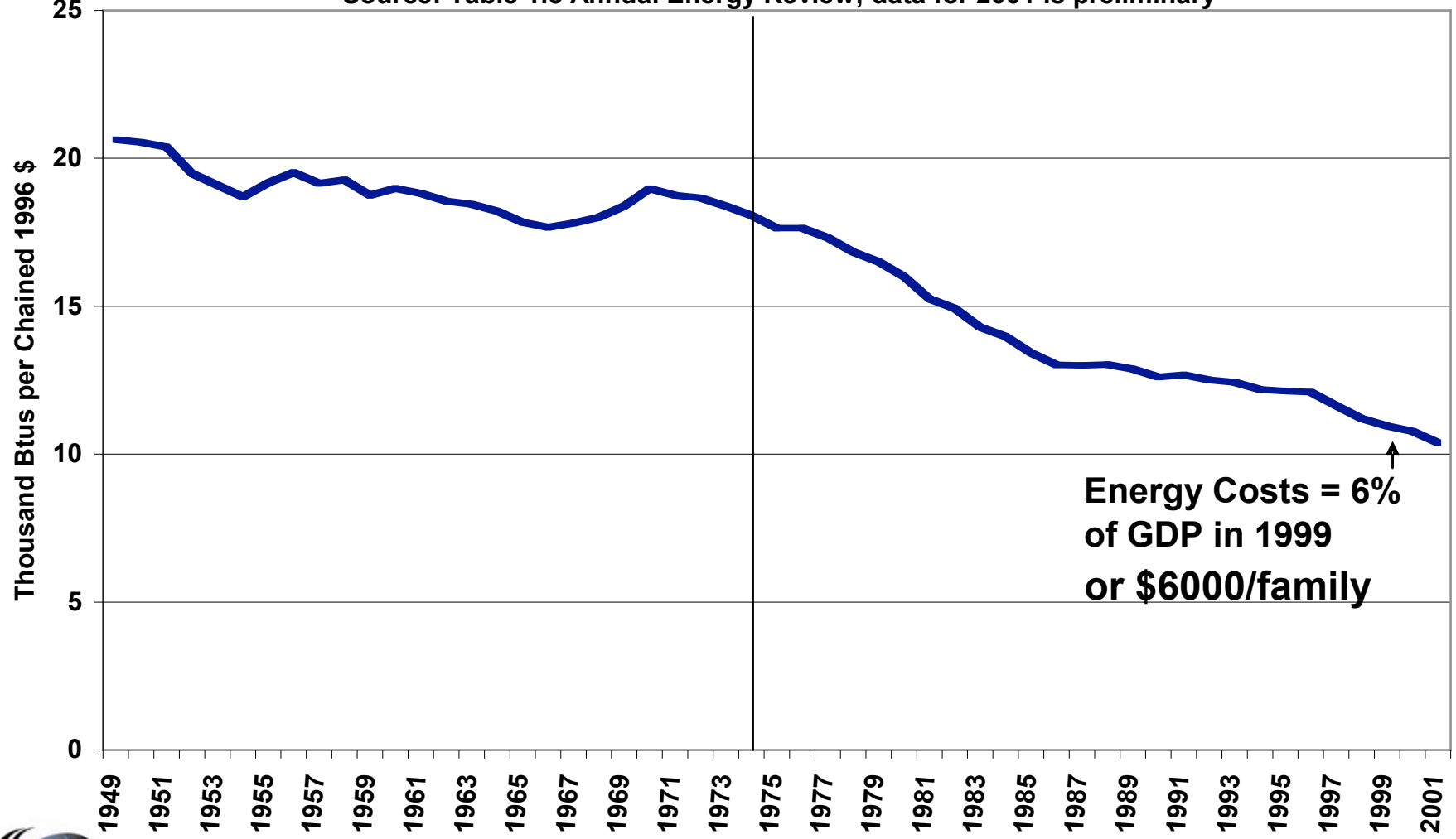


United States
Energy Consumption Per Person 1949 to 2001
Source: Table 1.5 Annual Energy Review; data for 2001 is preliminary



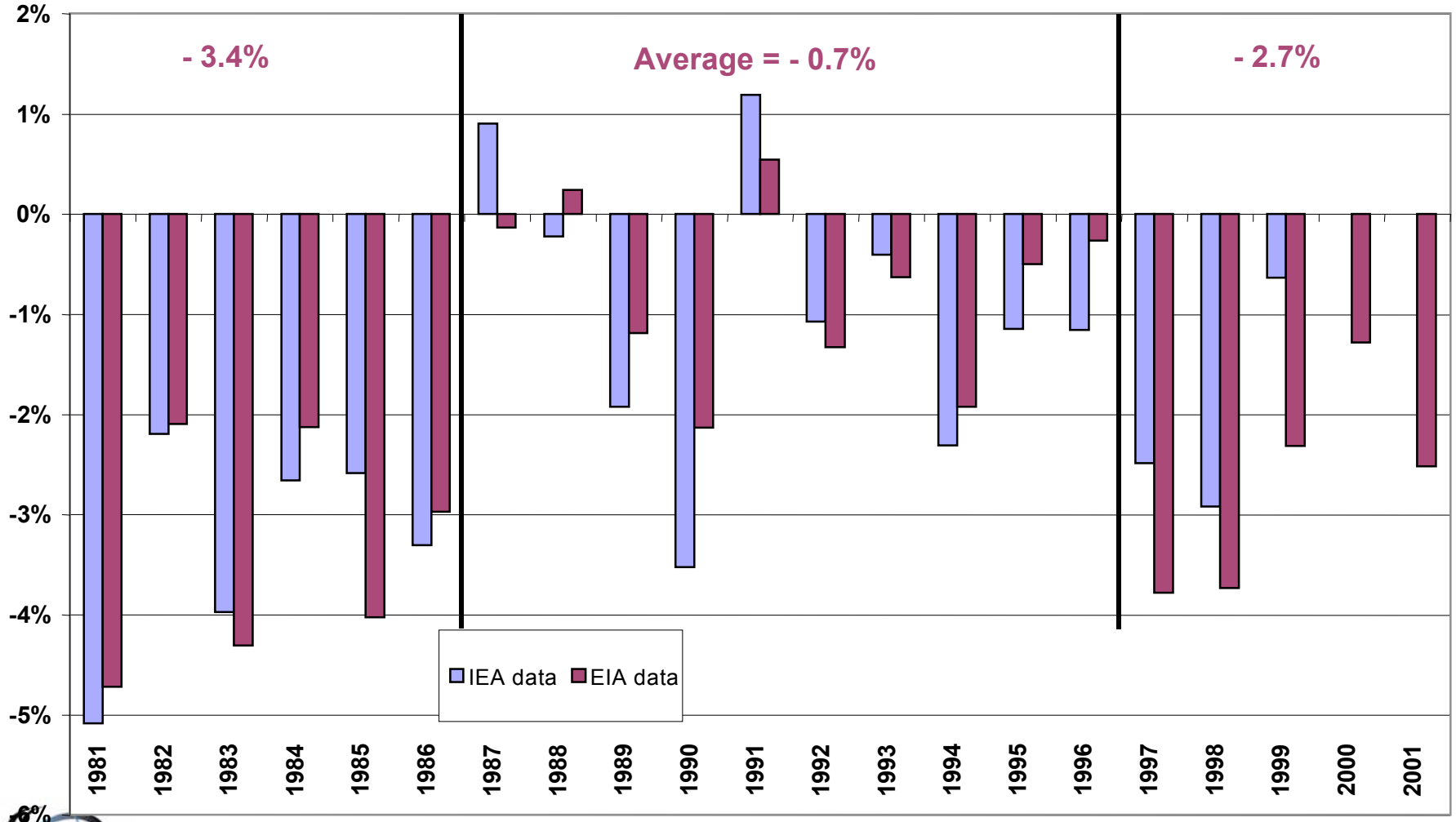
Energy Intensity in the United States
Energy Consumption Per $ of Gross Domestic Product 1949-2001

Source: Table 1.5 Annual Energy Review; data for 2001 is preliminary



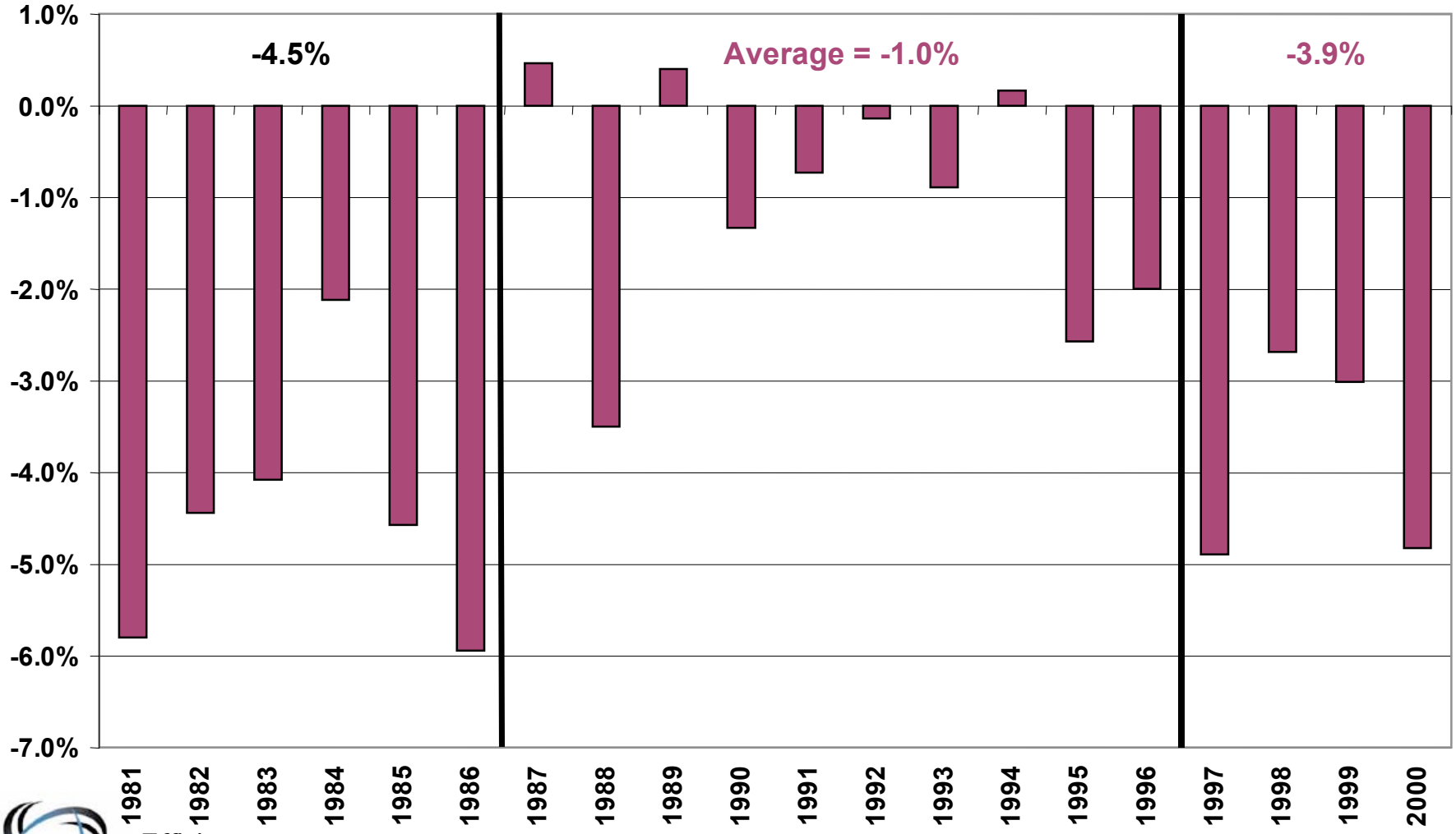
Annual Rate of Change in Energy/GDP for the United States

International Energy Agency (IEA) and EIA (Energy Information Agency)

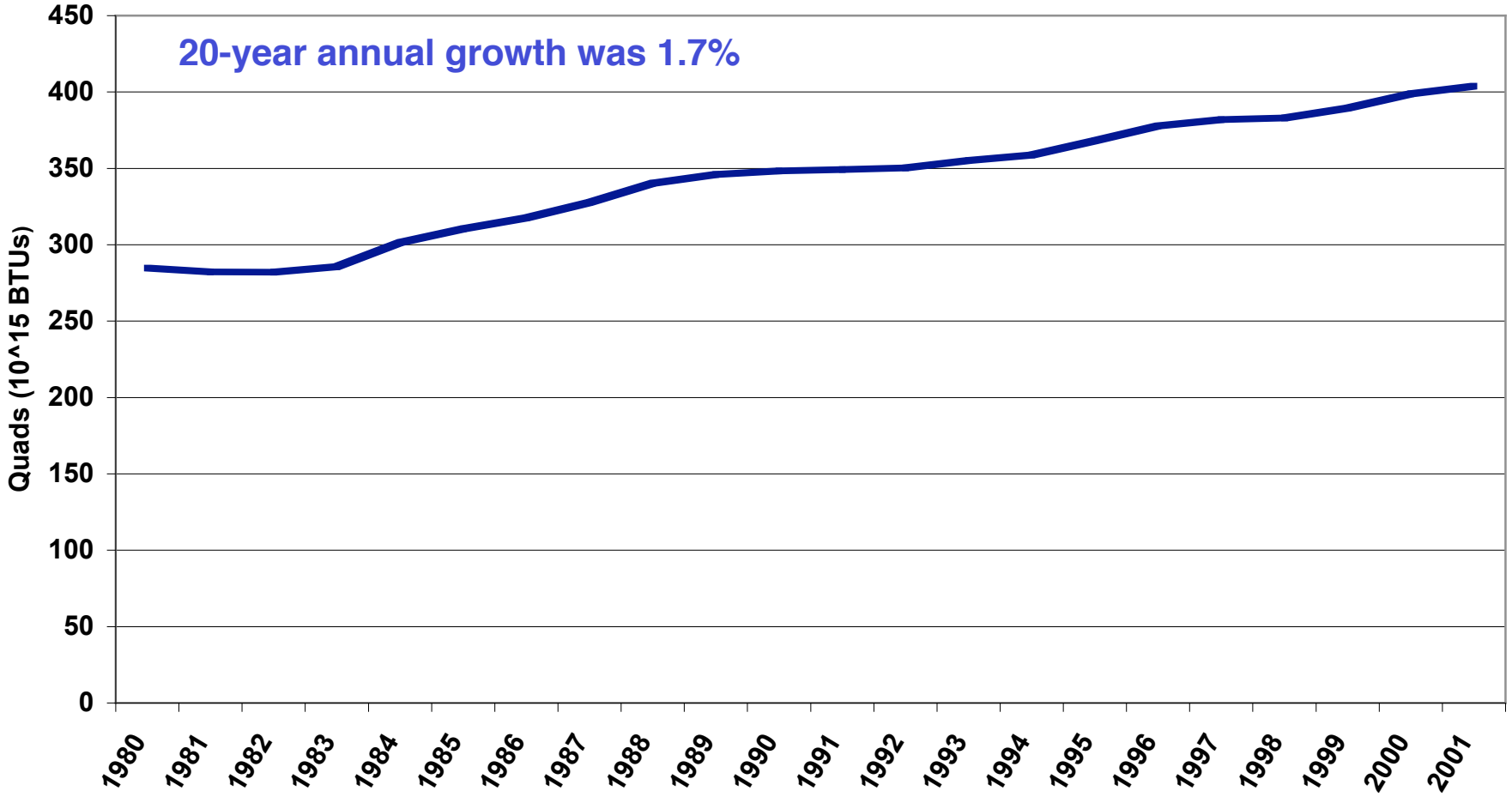


Annual Rate of Change in Energy/Gross State Product for California

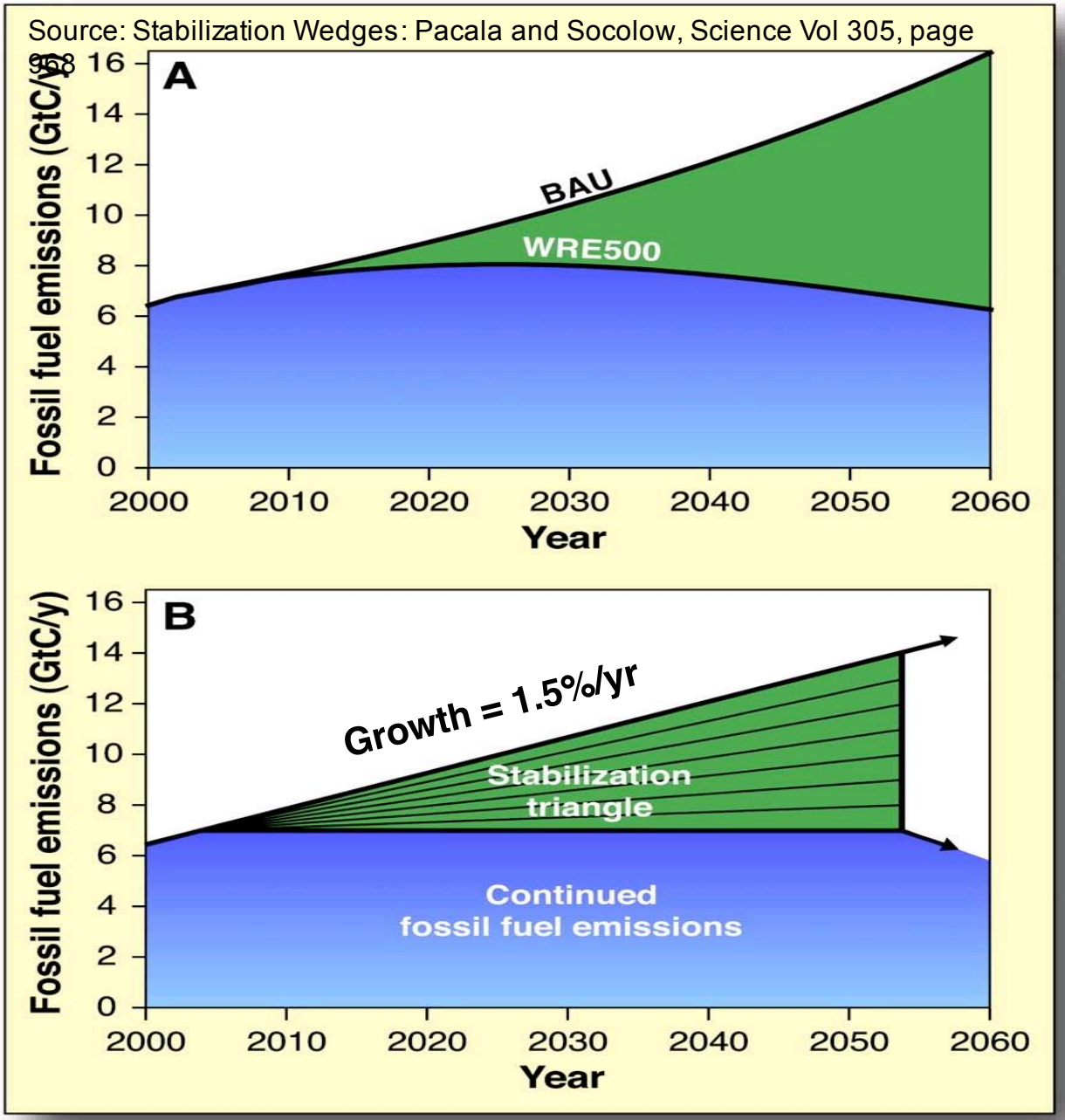
(Sources: EIA and California Department of Finance)



World Primary Energy Consumption
1980 to 2001
Source: EIA

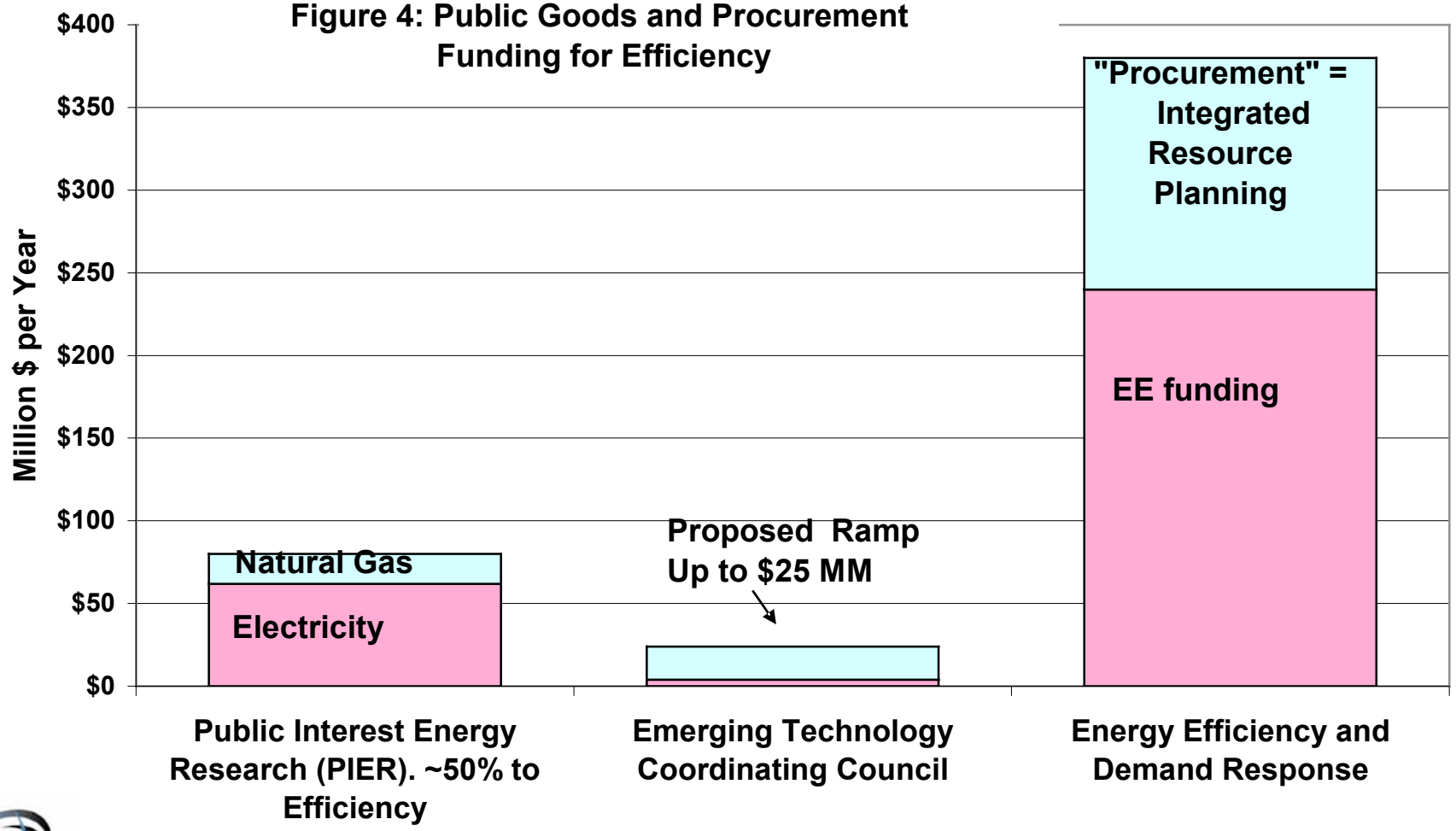


Source: Stabilization Wedges: Pacala and Socolow, Science Vol 305, page 968



Arthur Rosenfeld, Commissioner, California Energy Commission
Nancy Jenkins, PIER Buildings Program Manager, California Energy Commission
Robert Shelton, Managing Director, Navigant Consulting

Figure 4: Public Goods and Procurement Funding for Efficiency

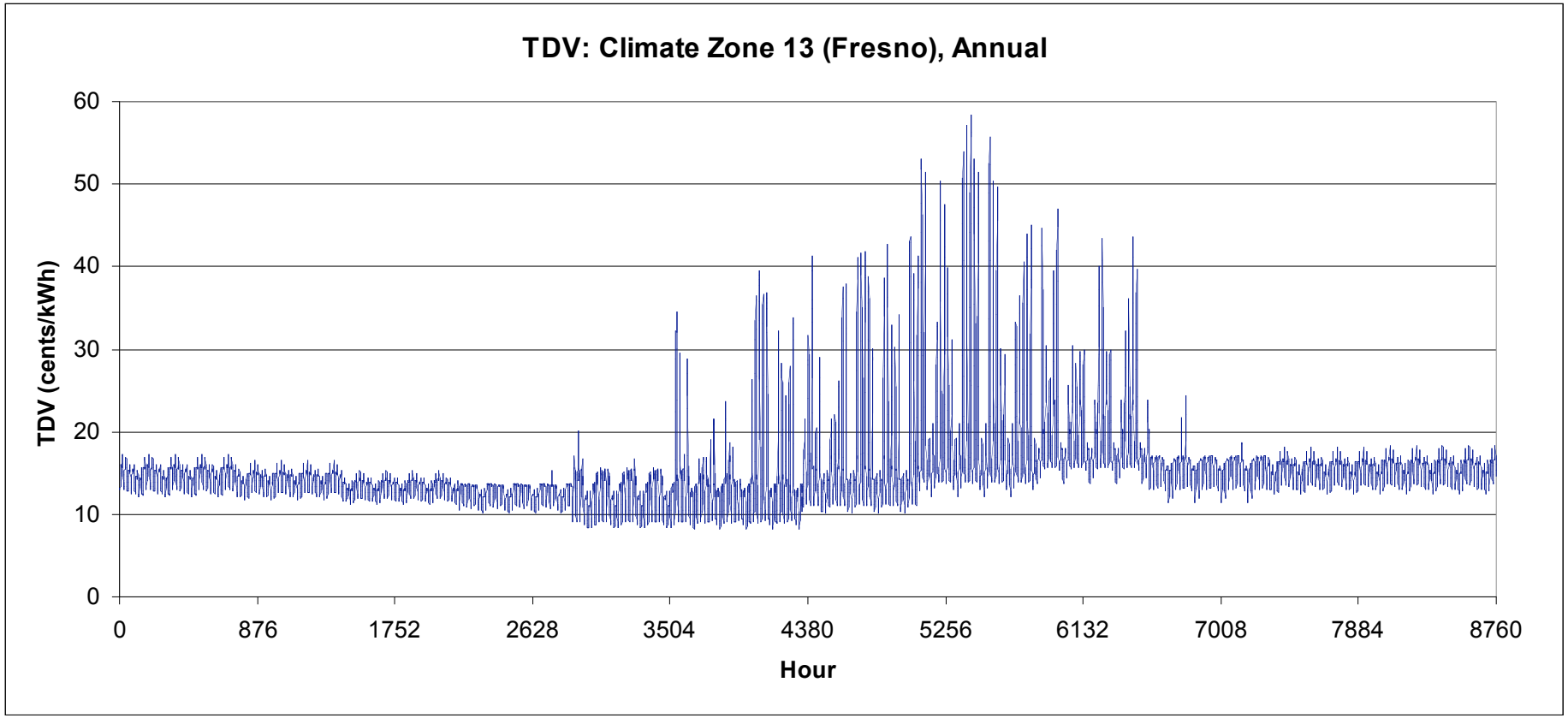


Demand Response and Interval Electricity Meters

- Currently large customers have interval meters, mandatory time-of-use pricing, and limited participation in interruptible programs
- Starting Summer 2006, these customers expected to be put on default Critical Peak Pricing (CPP) tariffs in IOU areas
- Also in 2006, PG&E and SDG&E expect to begin installation of interval meters for electricity customers and will relay gas use and will offer CPP to customers will meters
- Installation to take several years during which time SCE plans to follow suit
- CEC will define communicating thermostats which can be programmed to response to CPP and for grid protection

Time dependent valuation (TDV) prices vary over the year

- Although TDV prices in some hours exceed 50 ¢/kWh, annual average TDV price equals ~15 ¢/kWh



Cost of Conserved Energy (CEE) can also be used to evaluate designs

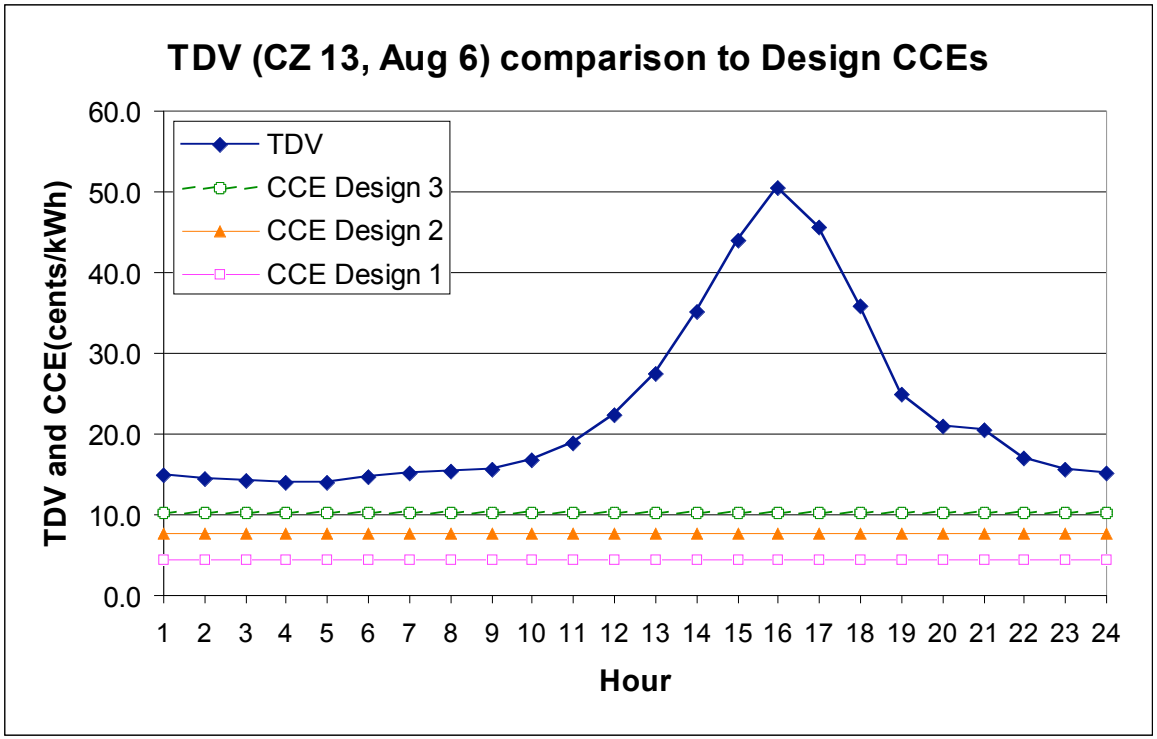
$$CCE = \frac{\Delta\$_{AC} \cdot CRR}{\Delta kWh_{\text{per year}}}$$

CEE = Cost of Conserved Energy

$\Delta\$_{AC}$ = Consumer price increase due to hot/dry AC design

CRR = Capital recovery rate; set at 10% per year

$\Delta kWh_{\text{per year}}$ = Annual energy savings due to hot/dry AC design



The California Clean Energy Fund (CalCEF)

A new $30 million fund formed to make equity investments in clean energy technology companies in California

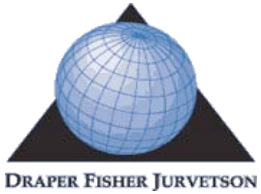
- Non-profit, public benefit, evergreen fund
- Established as a result of the Settlement Agreement between PG&E and the California Public Utilities Commission
- Mission is create an investment vehicle that serves as a catalyst to advance California's clean energy agenda
- Board of Directors blends public policy makers, investment professionals, and science and technology experts

Board of Directors

- **Michael R. Peevey (Chairman)**
  - President, California Public Utilities Commission.
- **Ralph Cavanagh**
  - Co-Director, Natural Resource Defense Council (NRDC) energy program. Member U.S. Secretary of Energy Advisory Board, 1993-2003.
- **Jonathan Foster**
  - General Counsel/VP Corporate Development, Atempo. Former deputy director of White House Office of Science and Technology Policy.
- **Tom Jacoby**
  - Founder/President Columbia Consulting Company; Director, Homeland Energy Resources Development Corp., Director, Environmental Entrepreneurs.
- **Mark Levine**
  - Director, Environmental Energy Technologies Division (EETD), LBNL
- **Nancy E. Pfund**
  - Managing Director, JPMorgan. Co-head JPMorgan's $75M Bay Area Equity Fund.
- **Arthur Rosenfeld, PhD**
  - Commissioner, California Energy Commission; Emeritus Professor of Physics, UC Berkeley
- **Mason Willrich**
  - Board of Governors, Cal-ISO, Former Nth Power partner; director of Evergreen Solar, founder and chairman of EnergyWorks LLC.
- **John Woolard**
  - Vice President of Strategy and Business Development of Itron, Inc. Co-founded and former CEO of Silicon Energy.

Experienced Investment Managers

- VantagePoint Venture Partners
  - Active multi-stage investor with more than $2.8 billion in capital under management



- Draper Fisher Jurvetson*
  - Early stage venture capital firm pursuing clean energy investment strategy

- Nth Power*
  - Dedicated exclusively to high potential investments resulting from the restructuring of the global energy industry

*Investment manager matching turns $30 million into $50 million

Broad Future Objectives

- **Grow Fund**. Raise additional equity in current fund. Add strategic partners.
- **Earliest Stage Investment Catalyst**. Find creative mechanisms for supporting high risk but promising clean energy investments. Partner with universities to create an environment of excellence.
- **Use Convening Power**. Promote leadership in clean energy technology. Attract additional investment to California.
- **Project Finance**. Create new solutions and new partnerships to address clean energy project finance.